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EXAMINER

STRZELECKA, TERESA E

ART UNIT

PAPER NUMBER

1637

DATE MAILED: 01/27/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/067,029

Applicant(s)

SUNDARARAJAN ET AL.

Examiner

Teresa E Strzelecka

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-- The MAILING DATE of this communication appears on the cover sheet with the corresponding address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 October 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 4-13 and 18-31 is/are pending in the application.
- 4a) Of the above claim(s) 5, 20 and 25 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 18, 19 and 21-23 is/are allowed.
- 6) ☒ Claim(s) 4, 6-13, 24 and 26-31 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 14 October 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
- a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

1. This office action is in response to an amendment filed October 14, 2003. Claims 4-13 and 18-31 were previously pending, with claims 5, 20 and 25 withdrawn from consideration.

Applicants amended claims 4, 13, 18 and 24.

2. Applicants' amendments overcame the following rejections: rejection of claims 4, 6-9, 11-13, 18, 19, 21-24, 26-28, 30 and 31 under 35 U.S.C. 102(b) over Wooley et al., and rejection of claims 10 and 29 under 35 U.S.C. 103(a) over Wooley et al. and Fisher et al.

3. Applicants' amendments necessitated new grounds for rejection presented below.

Claim interpretation

4. Before proceeding with the rejections, interpretation of claim limitations is provided.

Modification of a friction coefficient of a nanotube is interpreted as resulting from changing the chemical composition of a nanotube. Any such chemical composition change will result in modification of a frictional coefficient, according to Applicants' definition of a frictional coefficient: "A friction coefficient, by definition, describes forces of interaction between at least two objects or surfaces. A friction coefficient can be described as including both an abrasive component, and an adhesive component. Abrasive friction is defined as primarily a mechanical interaction between two objects. In one example of abrasive friction, resistance to movement at an interface between two objects is generated by asperities on the surface of the objects rising past each other or breaking off. In contrast, adhesive friction is defined as primarily a chemical interaction between two objects. A friction coefficient may be determined either by abrasive factors, adhesive factors, or a combination of the two." (page 2, lines 25-30; page 3, lines 1-3).

The limitations of increasing or decreasing a frictional coefficient of nanotubes refer to a measurement of a relative quantity, i.e., the same chemical modification of a nanotube measured

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against two different chemical surfaces may result in either decrease or increase in the friction coefficient.

Since any chemical modification changes friction coefficient of a nanotube, the steps of modifying a frictional coefficient of a nanotube and attaching the nanotube to a reactive molecule are interpreted as being the same step. Except for claims 18, 19 and 21-23, Applicants did not make a distinction between a “reactive molecule” and a “chemical modifier”, therefore these are interpreted as being the same molecule.

A limitation of claim 6, “an assay molecule”, is interpreted as any molecule, since it was defined in the specification.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

6. Claims 4, 6-9, 11-13, 24, 26-28, 30 and 31 are rejected under 35 U.S.C. 102(e) as being anticipated by Margrave et al. (U.S. Patent No. 6,645,455).

Regarding claim 4, Margrave et al. teach a method of derivatizing carbon nanotubes (see Abstract, for example), the method comprising:

a) modifying a friction coefficient of a carbon nanotube (Margrave et al. teach a modification of carbon nanotubes with fluorine groups which constitute reactive molecules (col. 3, lines 63-67; col. 4, lines 1-5). The fluorine atoms can then be substituted with other molecules, such as methyl lithium (col. 4, lines 6-22). Finally, more complex functional groups may be added to the side walls of the nanotubes (col. 10, lines 11-67; col. 11, lines 1-46).),

b) attaching the carbon nanotube to a reactive molecule (The attachment discussed above to the fluorine groups or other substituents represent attachment of the carbon nanotube to a reactive molecule, as well as modifying the frictional coefficient (col. 3, lines 63-67; col. 4, lines 1-5; col. 4, lines 6-22; col. 10, lines 11-67; col. 11, lines 1-46).),

c) selecting the carbon nanotube as a result of preferential interaction between the reactive molecule and sample molecule (Margrave et al. teach that fluorine modified nanotubes were selected on the basis of solvation in alcohol solvents (col. 13, lines 63-67; col. 14, lines 1-6).),

d) placing the carbon nanotube on a substrate (Margrave et al. teach that fluorine modified nanotubes were placed on a mica substrate (col. 13, lines 63-67; col. 14, lines 1-6).)

e) measuring the friction characteristics of the substrate to detect the carbon nanotube (Margrave et al. teach measurement of a frictional coefficient of the nanotubes by AFM (Atomic Force Microscopy) (col. 13, lines 63-67; col. 14, lines 1-6; Fig. 10, Fig. 12A and 12B)).

Regarding claim 6, Margrave et al. teach using the tip modified with a reactive molecule, fluorine, in an assay to determine its friction coefficient (col. 13, lines 63-67; col. 14, lines 1-6).

Regarding claim 7, the operations in the method of Margrave et al. were performed in the order presented (col. 13, lines 63-67; col. 14, lines 1-6).

Regarding claims 8 and 9, the friction coefficient of the nanotube is modified after attaching the reactive molecule, resulting in an increase in a friction coefficient, when measured against appropriate substrate (see claim interpretation; col. 3, lines 63-67; col. 4, lines 1-5; col. 4, lines 6-22; col. 10, lines 11-67; col. 11, lines 1-46).

Regarding claim 11, Margrave et al. teach attaching chemical species to the surface of the nanotube (col. 3, lines 63-67; col. 4, lines 1-5; col. 4, lines 6-22; col. 10, lines 11-67; col. 11, lines 1-46).

Regarding claim 12, Margrave et al. teach attaching carboxylic acid group to the surface of the nanotube (col. 11, lines 6-11).

Regarding claim 13, Margrave et al. teach measuring friction coefficient of a substrate by AFM (col. 13, lines 63-67; col. 14, lines 1-6; Fig. 10, Fig. 12A and 12B).

Regarding claim 24, Margrave et al. teach a method of forming a molecular identification assembly, the method comprising:

modifying a friction coefficient of a carbon nanotube (Margrave et al. teach a modification of carbon nanotubes with fluorine groups which constitute reactive molecules (col. 3, lines 63-67; col. 4, lines 1-5). The fluorine atoms can then be substituted with other molecules, such as methyl lithium (col. 4, lines 6-22). Finally, more complex functional groups may be added to the side walls of the nanotubes (col. 10, lines 11-67; col. 11, lines 1-46).); and

attaching the carbon nanotube to a reactive molecule (The attachment discussed above to the fluorine groups or other substituents represent attachment of the carbon nanotube to a reactive molecule, as well as modifying the frictional coefficient (col. 3, lines 63-67; col. 4, lines 1-5; col. 4, lines 6-22; col. 10, lines 11-67; col. 11, lines 1-46).)

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Regarding claim 26, the friction coefficient of the nanotube is modified after attaching the reactive molecule, resulting in an increase in a friction coefficient, when measured against appropriate substrate (see claim interpretation; col. 3, lines 63-67; col. 4, lines 1-5; col. 4, lines 6-22; col. 10, lines 11-67; col. 11, lines 1-46).

Regarding claim 27, the operations in the method of Margrave et al. were performed in the order presented (col. 13, lines 63-67; col. 14, lines 1-6).

Regarding claim 28, the friction coefficient of the nanotube is modified after attaching the reactive molecule (see claim interpretation; col. 3, lines 63-67; col. 4, lines 1-5; col. 4, lines 6-22; col. 10, lines 11-67; col. 11, lines 1-46).

Regarding claim 30, Margrave et al. teach attaching chemical species to the surface of the nanotube (col. 3, lines 63-67; col. 4, lines 1-5; col. 4, lines 6-22; col. 10, lines 11-67; col. 11, lines 1-46).

Regarding claim 31, Margrave et al. teach attaching carboxylic acid group to the surface of the nanotube (col. 11, lines 6-11).

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 10 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Margrave et al. (U.S. Patent No. 6,645,455) and Fisher et al. (U.S. Patent No. 6,203,814 B1; cited in the previous office action).

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A) Claim 10 is drawn to a method of claim 4, wherein modifying the friction coefficient of a carbon nanotube includes acid treating the carbon nanotube, and claim 29 is drawn to a method of claim 24, wherein modifying the friction coefficient of a carbon nanotube includes acid treating the carbon nanotube.

B) Margrave et al. teach modifying the friction coefficient of a carbon nanotube by attaching carboxylic acid to the nanotube, but do not teach treating the nanotube with acid.

C) Fisher et al. teach attaching carboxylic acid to carbon nanotubes by treating the nanotubes with nitric acid (col. 15, lines 54-67).

It would have been *prima facie* obvious to one of ordinary skill in the art at the time of the invention to have used nitric acid treatment of Fisher et al. in the method of carbon nanotube modification of Margrave et al. The motivation to do so, provided by Fisher et al., would have been that treatment with nitric acid removed undesirable materials from the surface of nanotubes in addition to functionalizing them (col. 3, lines 22-34).

9. No references were found teaching or suggesting claims 18, 19, 21-23, therefore they are allowed.

Conclusion

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the

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date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Teresa E Strzelecka whose telephone number is (571) 272-0789. The examiner can normally be reached on M-F (8:30-5:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gary Benzion can be reached at (703) 308-1119. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0196.

Gary Benzion will move to the new office on January 22, 2004. His new phone number is (571) 272-0782.


JEFFREY FREDMAN
PRIMARY EXAMINER

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January 22, 2004